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ON SOME PECULIARITIES OF MAGNETIC FIELDS LINKED WITH SOLAR FLARES

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ABSTRACT.

Changes in the configurations and gradients of magnetic fields related to solar flares are confirmed by new measurements [3]. Preliminary results of transverse field observations in regions with flare development are presented. It is found that the field configuration in these regions is characterized by a cross-over or "coexistence" of magnetic fields with different directions (Fig. 1). It is noted that chromospheric filaments with different directions are often observed in the bright regions of flares on spectroheliograms (Fig. 2). The coexistence of fields with various directions inside sunspots is frequently observed. In particular, small inclusions of the transverse field are also fairly often observed in the regions of same polarity (Fig. 3). The strange character of such magnetic configurations calls for an explanation.

* * *

COVER-TO-COVER TRANSLATION

1. Introductory Remarks.- In order to clarify the question whether flares are the results of thermal or elecromagnetic nature, it is very important to study whether their occurrence is linked

* O nekotorykh osobennostyakh magnitnykh poley svyazannykh so vspyshkami.

with a specific magnetic field configuration or not. At the same time we have in mind a flare at the very beginning of its occurrence, for at its further development the flare spreads eventually in quiet a fancy fashion over a large surface, possibly under the effect of causes having nothing to do with its formation.

Basing ourselves upon the maps of the longitudinal component of the magnetic field $H_{\parallel}$, we could note in 1958 - 1959 a tendency for the flares to occur over the line $H_{\parallel} = 0$, possibly th field's zero points [1, 2]. Another indication on the electromagnetic nature of the phenomenon was the fact that the longitudi-tudinal field $H_{\parallel}$ showed variations (seven times in eight), if one made comparison of its state prior and after the flare : After the flare the field is simpler and its gradients lesser than prior to it. (see ref. [2]).

Recently configurations of the magnetic field before and after the flare were analyzed for 51 flares [3], including 24 flares attended by the effect in cosmic rays registered either on balloons or in the form of polar blackout (PCA). The results of this analysis, reproduced in Table 1, clearly point to field gradient decrease after the flare. (The gradients brought out here are related to the field's zero point in the region of the flare, refer to [3]).

Thus, more recent data again indicate variations of the field at flares.

TABLE 1.

F L A R E S	Number	$(\nabla H)_0$ gauss/km	
		before	after
Force 3+, cosmic rays (balloons)	13	0.73	0.25
Force 3 and 3+ (blackouts)	11	0.46	0.27
Force 3 without geophys.effects	12	0.18	0.13
Force 2 and 2+	15	0.054	0.038

Measurements of field's $H_{\parallel}$ transverse component, started recently and provided important material on field configurations at which flares occur. We are bringing forth below, though still preliminarly, some surprising properties of these configurations.

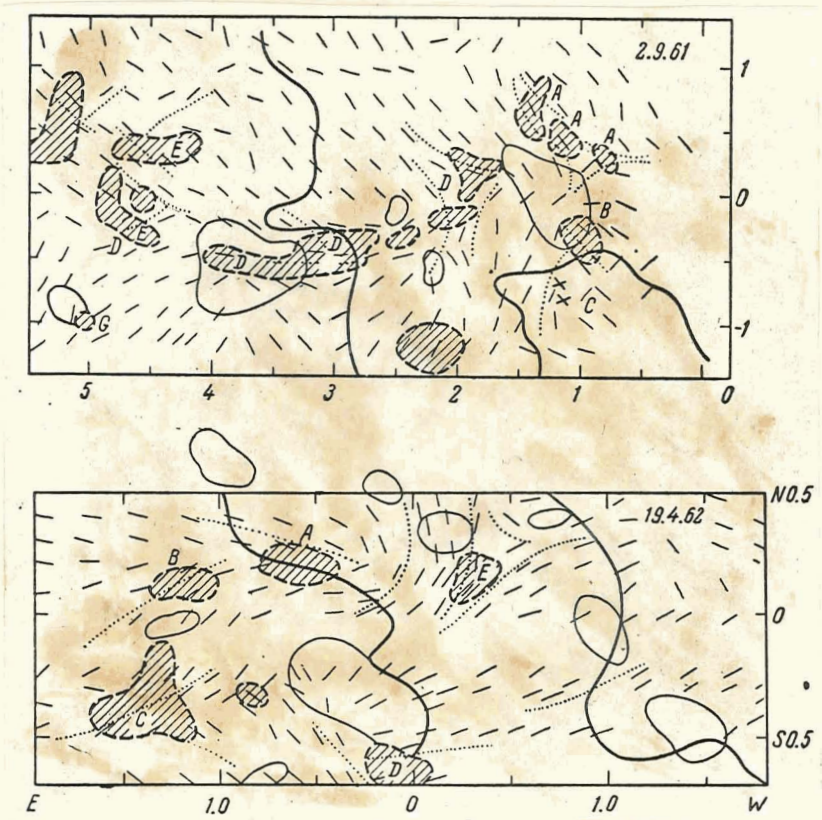

Fig. 1. Examples of a map giving the directions of the transverse field $H_{\perp}$ in active regions where flares occurred (shaded spots). Each large scale division along the vertical and horizontal constitutes 25". For other explanations, see the text.

2. On Transverse Fields in the Region of the Flare.

Examples of maps with transverse field $H_{\perp}$ directions (traits) are given in Fig. 1, where also noted are the positions of the cores of spots (closed solid lines) and flares (dotted

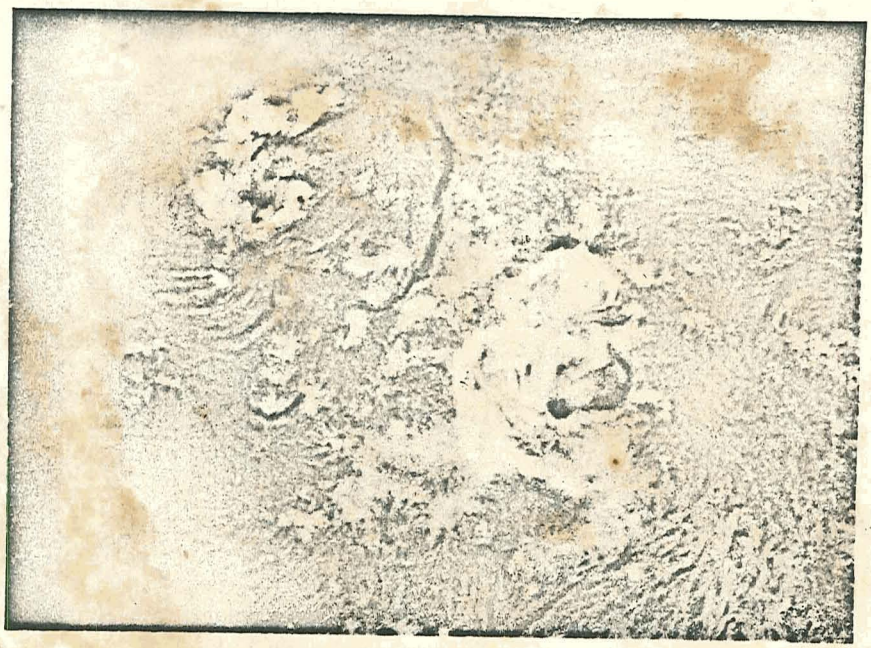

Рис. 2. Вспышка 16.IX 1957 г. 7^h40^m Московского времени
Fig. 2. Flare of 16 Sept.1957 at 07 40 hrs Moscow Time.

contours, shaded regions, crosses indicating the position of "whiskers"). The directions are obtained by utilizing the obvious correlation (see the description of the method in ref. [4]):

$$\operatorname{tg} 2\chi = \frac{\delta_{i_1}}{\delta_{i_2}}$$

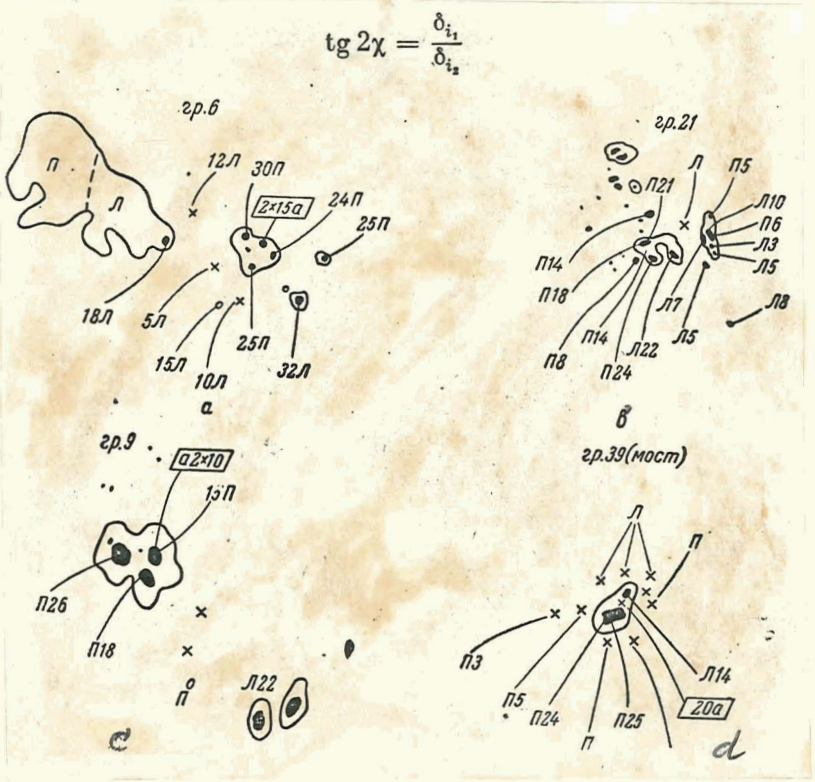

Fig. 3. Examples of sketches of spot groups with field determinations, П is the southern polarity, Л — the northern polarity, the numbers corresponding closely to field intensity in gauss : a — 1 Febr.1962, 15 25 — 16 45 hrs ; b — 29 March 1962, 11 15 — 11 30 hrs, c — 16 Apr.1962, 09 10 — 10 10 hrs ; d — 23 Sept.1961, 08 00 — 08 10 hours.

where χ is the angle between $H_{\perp}$ and the direction of the extraordinary axis of the record $1/4\,\lambda$ and δ_{i_1} and δ_{i_2} are the magnetograph signals at the record's installation (of quarts) at 45° angle with polarizer direction and at a 90° angle

Attention is also called by the intersection or crossing points or places where the fields branch out in different directions (indicated by dots). So far we have not found a single flare which was situated outside these spots. In particular these spots are situated on the zero line $H_{||} = 0$ (heavy solid line), however flares occur also outside this line (but at the indicated field crossing spots). It is interesting to note that in the just published investigation [5] several maps of $H_{\perp}$ are brought out, which show the same effect of flare disposition at points of field $H_{\perp}$ direction branchings, though the author [5] himself did not notice that fact. We must however bear in mind that flares do not necessarily occur at any such spot.

It is possible that the fact of flare occurrence at branching spots of $H_{\perp}$ directions is reflected in spectroheliograms in that in the bright region of the flare (or of floccule brightening) the oriented chromosphere filaments are differently observed (sometimes at right angle) (see Fig. 2).

The " coexistence" of differently oriented fields within spots, first noted by us for the cores of large spots [6], are fairly frequently observed, as may be seen from the usual daily field and group observations within the solar program: very small "disseminations" of the transverse field occur at times in regions, fully occupied by a field of same polarity, as may be seen from Fig. 3 (here we also brought out an example 3, c of coexistence in a small core of two polarities, and also an example of a "bridge" when a transverse field appears between two polarities — case quite comprehensible and trivial, as seen in Fig. 3d).

It is thus far difficult to point to a certain analogue of terrestrial experiment for the observed rather strange configurations of the field, ot to provide for them a satusfactory explanation. It is possible that the effect is related to altitude dif-

ference in the position of fields with various directions, although the layer, to which measurements refer, is very narrow ($\leqslant 500$ km). All these facts call for a further detailed study.

***** THE END *****

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